medico-legal point of view, and remained undisputed for a long time. M. Raspail, however, has most incontestably shown that neither the method of Orfila or the still later one proposed by Barruel can be depended upon, as they may lead to the most unfortunate results if adduced as evidence in cases of suspected murder.

We shall not pursue our examination of M. Raspail's work any further, for, as we have already stated, to enter on its contents fully would require as many pages as are contained in the treatise itself; our design will be answered if we shall have excited a desire in our readers to study it themselves, as we feel convinced that it will amply repay the time bestowed upon it, for although there is much in it that s unsubstantiated, and not a little that had better have been omitted, taken as a whole we consider it as one of the most useful works on organic chemistry and physiology that has appeared for a length of time, and we trust that the author may be enabled to revise it in such a manner as to render it of still greater utility. R. E. G.

Art. XVII. *The Hand, its Mechanism and Vital Endowments, as Evincing Design.* By Sir Charles Bell, K. G. H., F. R. S. L. & E. Philadelphia, Carey, Lea & Blanchard, 1833. pp. 213.

THE origin of the Bridgewater treatises, of which this is one, has been so extensively made known, that we avoid giving an account of it here, although this would seem to form the most natural introduction to our review. The common object to be fulfilled by the writers, is to illustrate "the power, wisdom, and goodness of God, as manifested in the creation." It is a noble, but at the same time a most difficult theme. Man is placed at an infinite distance from the throne of the Almighty, and yet in his self-conceit he thinks that "he can by wisdom find out God," and he pronounces with presumptous confidence upon the designs and motives of the Divine government. We remember to have heard Mr. Corrêa de Serra call the searchers after final causes, the *coffee-house politicians of heaven;* and they but too often merit the ridicule so strongly expressed in these words.

There is certainly no occupation more worthy of engaging the efforts of man, than the study of the works of God; and in consideration of the difficulty of the task and the feebleness of his powers, he may well be excused, if he sometimes take erroneous views of nature. But let him beware how he rashly pronounces his views to be those which governed the Creator; let him be cautious, even how he expresses his admiration of what he conceives to be the contrivances of Divine wisdom, lest he should "praise amiss." It is well-known that Paley, though master of the general argument on which natural theology is founded, committed many errors in the details, and it is painful to observe that he finds the evidences of wise design no less where he is wrong, than where he is right. In "the harmonies of nature" of St. Pierre, this eloquent writer meets with continual subjects of admiration, in a system which often owes its existence only to his own poetical fancy, and which nature herself would never acknowledge. Even our author, though in general cautious and correct, is not always free from this fault of misplaced admiration, as the following example will show.

While defending the economy of nature in certain animals, which, by their languid movements, have excited the compassion of some philosophers, he says, of the chameleon.—"He protrudes his tongue with a motion so imperceptible towards the insect, that it is touched and caught more certainly than by the most lively action." Now, it has happened to us to see the chameleon catching flies, and *our* admiration was excited by the fact that it protruded its tongue with such rapidity as to allow the insect no time for escape. It is true that the chameleon makes its approaches so slowly and cautiously as not to excite alarm; but when it has brought its prey within reach of its long tongue, the last fatal attack is made with a quickness singularly in contrast with the general habits of the animal.

Again, when speaking of birds, our author says—

> "It is interesting to notice the relations of great functions in the animal economy. Birds are oviparous, because they never could have risen on the wing had they been viviparous; if the full stomach of a carnivorous bird retard its flight, we perceive that it could not have carried its young. The light body, the quill-feathers, the bill, and the laying of eggs, are all necessarily connected."

Doubtless, it is a wise provision of nature that birds should produce their young by eggs, but that this was not a necessary condition of the power of flying is fully shown in the bat, which is a viviparous animal, and yet flies extremely well. Nature seems to delight in overthrowing our plausible speculations. In contemplating the singular structure of fishes, so admirably adapted to the element in which they live, we should be tempted to suppose that this structure alone could be consistent with the circumstances of these inhabitants of the deep, did not the whale, the dolphin, &c.—those mammiferous fishes, those bats of the ocean, present themselves to refute our theories, and to prove that the resources of nature are not limited to the conceptions which we may form of them.

We do not mean by these remarks to discourage attempts to fathom, as far as we can, the motives and plans of the Creator in his works. On the contrary, we consider this to be the true philosophy of natural history. But we would insist upon the duty of conducting these researches with the humility and timidity, suited at once to our own limited knowledge and understanding, and "to the height of the great argument." There are not wanting abundant examples of contrivance in the works of nature, of which the object admits of no doubt, and which if rightly interpreted, point with an evidence not to be resisted to the existence of an intelligent and beneficient Creator. To bring forward disputed cases, therefore, and to insist upon ascribing to the Deity our own views, is useless even if we should be right, and if we should prove to be wrong, is a serious injury to the cause of truth.

It is remarkable that the contrivances of nature that most excite our admiration are the most simple, such as the pulley muscle of the eye, and the perforating and perforated tendons of the hand. We see, or think we see, clearly, the object of the Divine mechanic in these parts of his machinery; we seem even to comprehend the train of thought that led to their formation. From such examples, (and they are numerous,) we pass to the contemplation of more complicated organs, such as the eye itself, of which, as an optical instrument, we have also a tolerably clear conception. At length we are lost in mazes of difficulty, and apparent complication. In the mysterious means by which the individuals and the races of living beings are continued in existence, in the functions of motion and sensation, and especially in that of thought, we have the organs offered to our examination, but we find that our understandings are too limited to comprehend them. Still we cannot doubt that these organs are mechanisms not differing in kind from those which we can comprehend, though differing from them in degree, to an extent far beyond the reach of our intelligence. When we turn our thoughts to the divine inventor and constructor of these wonderful contrivances, our conclusions follow an analogous course. In the most simple cases, we see evidences of a train of thought such as our own minds might be capable of, and we naturally conclude that the whole mechanism of nature may therefore have resulted from the high meditations of a perfect and infinite *mind.* Even the most exalted attributes of the Deity are not inconsistent with this view of his nature. What conception of his omniscience, for example, can be so intelligible, and at the same time so sublime as that which is suggested by the following passage from Laplace's "*Essai Philosophique sur les Probabilités?*"

"We must look upon the present state of the universe, as the effect of that which is past, and as the cause of that which is to follow. An intelligence which at any given instant should know all the forces with which nature is animated, and the respective situations of the objects which compose it, if moreover it were sufficiently vast to submit these data to calculation, would embrace, within the same formula, the movements of the greatest bodies of the

> universe, and those of the lightest atom. For such a being nothing would be uncertain, and the future and the past would be equally present to his eyes. The human mind offers, in the perfection which it has been able to give to astronomy, a feeble sketch of this intelligence. The discoveries in mechanics and mathematics, joined to that of universal gravitation, have enabled the astronomer to comprehend, in the same analytical expressions, the past and future states of the system of the world. By applying the same method to other objects of knowedge, man has been enabled to reduce the phenomena observed to general laws, and to foresee those which would be produced under other given circumstances. All his efforts in the research of truth tend to bring him nearer and nearer to the intelligence of which we have been forming a conception, though his distance from it must forever remain infinite."

For the first step in the study of natural theology, namely, the explanation of some mechanism within the reach of our comprehension, there is perhaps no object better suited to the purpose than the *hand*, as it exists in man, and as it is presented, under various and singular modifications, in other animals. Accordingly, this topic is expressly named in the testament which has given origin to the Bridgewater Treatises, and is now presented to the public in the work of Sir Charles Bell. The subject is admirably fitted for an essay, admitting of unity without sameness, and variety without confusion. The order to be followed seems to be pointed out so clearly and naturally, that one would suppose no other could be chosen. It is, we should think, to treat first of the human hand, considered in connexion with the whole upper extremity; to describe the bones, and the manner in which they are bound together by cartilages; then the muscles—the beautiful arrangement of the tendons—and the manner in which all the movements of the hand are effected; then the arrangements of the nerves, which convey the commands of the will to the hand, as its chief minister, and which carry back to the brain the impressions made upon the hand as the great organ of touch. In considering these parts of our structure, clear evidences of design would continually present themselves, and might serve as so many texts for inculcating the great doctrine for which the work was written.

After treating of the human hand and arm, a vast and most interesting field of inquiry would still be left, in the modifications of the same general mechanism, presented in the corresponding limb of other animals, and in the evident, wise, and benevolent adaption of these changes to the circumstances of the animal. In this part of the work, a natural and luminous order would be attained by considering first those animals in which the anterior extremity differed least from that of man, and afterwards proceeding, step by step, to the lowest orders of the *vertebrata*, or even to the classes still further removed from the great model. In pursuing these subjects, the author might be indulged in occasional excursions into other fields of research, and thus might be formed a work full of interest and instruction, in which "the ways of God would be justified," and "eternal providence asserted."

Such was the work that we expected from Sir Charles Bell. But what has he really given us? A mass of confusion—a maze without a plan: the most obvious business of the work wholly neglected, and extraneous matters forced in without a thread of connexion. It is not without pain that we give so unfavourable a judgment, but candour requires it at our hands as impartial critics. We cheerfully acknowledge the great talents of the author—we are grateful to him for the important contributions which he has made to physiology—we find, even in the work before us, interesting and ingenious views which show his research and his sound sense; but these circumstances only make us the more regret that such an author should mar the usefulness of his work by glaring omissions, extraneous matter, and a confused plan.

Will our readers believe us when we tell them that this treatise on the hand gives no where a description of the hand? Yet such is the strange fact. We find, indeed, in the title page, the words—"The Hand, its Mechanism, and Vital Endowments;"—and we find in the table of contents, "the mechanism of the hand," mentioned as one of the subjects of Chapter II.; but these are the only places in the book in which we meet with any thing about this mechanism. If we turn to the single page, (27,) to which the table of contents refers us for this account of the "construction of the hand of man,"—the very business of the author's task, for which he received from the bequest of the Earl of Bridgewater a thousand pounds sterling, we shall find the following paragraph to be the only one that could be meant.

> "But the hand is not a distinct instrument; nor is it properly a superadded part. The whole frame must conform to the hand, and act with reference to it. Our purpose will not be answered by examining it alone; we must extend our views to all those parts of the body which are in strict connexion with the hand. For example, the bones from the shoulder to the finger ends, have that systematic arrangement which makes it essential to examine the whole extremity; and in order fully to comprehend the fine arrangement of the parts, which is necessary to the motions of the fingers, we must also compare the structure of the human body with that of other animals."

Is this an account of the mechanism of the hand? If it be not, it will be found no where else. The paragraph seems, however, to point out a course which might lead, in the end, to this avowed object of the treatise. Let us see how this plan is pursued. First the author defines the term skeleton; then he speaks of the function of respiration, and of the class of vertebrated animals; he then alludes to the bones which, in other animals, correspond to those of the upper extremity in man, and glances at their singular modifications and adaptations; then he passes off to the subject of fossil remains, and speculates about the former states of the earth—a favourite topic, which is resumed again and again in this work on the human hand; next we have a defence of the sloth and other tardigrade animals, and an account of the manner in which the author supposes that the chameleon catches flies, and in which certain spiders actually do catch them; then our author returns to the antedeluvian world, in which he dwells for four or five pages, indulging himself in speculations about the balance of power among the animals now extinct. Lastly, there is a premature discussion of certain false notions of the modern system-makers—a discussion to be again resumed in other places. Such are the multifarious and incongruous topics considered in the only chapter to which we are directed for a description of the mechanism of the hand.

Disappointed here, we still look, with some hope, to the next chapter, which is headed—"The Comparative Anatomy of the Hand." Our encouragement is increased, when we meet with the author's good resolution, as expressed in the following paragraph:—

> "Were it my purpose to teach the elements of this subject, I should commence with examining the lowest animals, and trace the bones of the anterior extremity as they come to resemble the human arm, and to be employed for a greater variety of uses in the higher animals; but as my present object is illustration only, I shall begin with the human hand, and compare its parts. With this view, I shall divide the extremity into the shoulder, arm, and hand, and treat each subdivision with a reference to its structure in animals."

In compliance with this plan, the author, in the very next paragraph, considers—what think you reader?—why, the strength and solidity of the lower extremities—the length of these limbs—the width of the pelvis—the distance of the great trochanters from the sockets—the size and prominence of the processes—the mass of muscles on the loins and hips—and the contrast of all these with the corresponding parts of the chimpanzee, an ape which stands high in the order of the quadrumana!

After this, indeed, the author seems to enter upon his appointed work, and treats of the bones of the shoulder and arm, though most vaguely, and not without numerous wide digressions, some of which are into his favourite regions of the antediluvian world. At last we come to the title "Of the Wrist and Hand," and we have hopes that some portion of the thousand pounds sterling bequeathed for the account of the "construction of the hand of man" will now be earned. But the whole of the money's-worth is included in the following extract:—

> "In the human hand, the bones of the wrist (carpus) are eight in number; and they are so closely connected that they form a sort of ball, which moves on the end of the radius. Beyond these, and towards the fingers are the metacarpal bones, which diverge at their further extremities, and give support to the bones of the fingers. The thumb has no metacarpal bone, and is directly articulated with the carpus or wrist. There are thus in the hand twenty-nine bones, from the mechanism of which, result strength, mobility, and elasticity."

Here the author's theme came full before him, but he starts from it, as from a spectre, and gives us an intelligible and really interesting account, not of the human hand, but of the fore-leg of the horse. All the remainder of the chapter is taken up with miscellaneous observations of comparative anatomy, from which we select the following:—

"I have alluded to the observation of President Jefferson on the Megalonix. Having found a bone, which by its articulating surface and general form, he recognised to be one of the bones of the phalanx of an animal of great size, he thought he could discover that it had carried a claw; and from this circumstance, he naturally enough concluded, (according to the adage—ex ungue leonem,) that it must have belonged to a carnivorous animal. He next set about calculating the length of this claw, and estimating the size of the animal. He satisfied himself that in this bone, a relic of the ancient world, he had obtained a proof of the existence, during these old times, of a lion of the height of the largest ox, and an opponent fit to cope with the mastodon. But when this bone came under the scrutiny of Baron Cuvier, his perfect knowledge of anatomy enabled him to draw a different conclusion.

"He first observed that there was a spine in the middle of the articulating surface of the last bone, which in this respect was unlike the form of the same bone in the feline tribe. He found no provision in this specimen of an extinct animal, for the lateral attachment of the bone, which we have just noticed to be necessary for its retraction. Then observing what portion of a circle this bone formed, he prolonged the line, and showed that the claw belonging to it must have been of such great length, that it could never have been retracted to the effect of guarding an acute and sharp point. The point, therefore, could not have been raised vertically, so as to have permitted the animal to put the foot to the ground without blunting the instrument! Pursuing such a comparison, he rejected the idea of the bone belonging to the feline tribe at all. His attention was directed to another order, the paresseux or sloths, which have great toes and long nails. Their nails are folded up in a different fashion; they just enable the animal to walk; but slowly and awkwardly, something in the same manner as if we were to fold our fingers on the palm of the hand, and bear upon our knuckles. On instituting a more just comparison between these bones of the ancient animal, and the corresponding bones of the paresseux, he has satisfied us, that the lion of the American President was an animal which scratched the ground and fed on roots.

"One experiences something like relief to find that there never was such an enormous carnivorous animal as this, denominated Megalonix."

Chapter IV. professes to treat "of the muscles," and begins with the following luminous definition. "The muscle of the body is that fleshy part with which every one is familiar." Some general views of muscular action are then presented, and nature is successfully defended as to the supposed mechanical disadvantage at which most of the muscles seem to operate. At last the student of natural theology arrives at the point at which he is to look for a description of the machinery by which the infinitely varied motions of the hand are effected—he feels himself under the influence of a rational, a pious curiosity, and he meets with the following paragraph.

"The demonstration to the anatomical student of the muscles of the human hand and arm, becomes the test of his master's perfection as a teacher. Nothing is more uninteresting, tedious, and difficult to attend to, than the demonstration of the muscles of the arm, when they are taken successively, as they present themselves; but when they are taught with lucid arrangement, according to the motions performed by them, it is positively agreeable to find how much interest may be given to the subject.

"It would be foreign to the object of this work to introduce such demonstrations here."

Foreign to the object of this work! Astonished by this strange assertion, we turn to the will of the "right honourable and reverend" founder of the project, and we find the following words:—

> "The testator further directed that the person or persons selected by the said president, should be appointed to write, print, and publish one thousand copies of a work, on the power, wisdom, and goodness of God, as manifested in the creation; illustrating such work by all reasonable arguments, as for instance—*the construction of the hand of man*, &c."

For this special task Sir Charles Bell has received a thousand pounds sterling, and the copyright of his work, which we suppose to be worth as much more, for every body will be expected to read the Bridgewater treatises. Yet, when, in the course of his vague disquisitions, he is called upon, by an accidental approach to his subject, to explain the "construction of the hand of man," he casts it by, with the declaration that it is *foreign* to the object of the work! Now, we would ask if it be possible to form any notion of the construction, or, (to use the word which figures in the title page,) the *mechanism* of the hand, without explaining the arrangement and action of the muscles which belong to it. We would ask, too, whether there be any example in the whole animal economy, in which "design" is more clearly evinced; in which "the power, wisdom, and goodness of God" are more evidently exhibited.

The careful exclusion from this work of all account of "the mechanism of the hand," reminds us of a bill stuck up by a company of strolling players, in which they announced "Shakspeare's celebrated tragedy of Hamlet, Prince of Denmark," with the following notice: "N. B. The part of Hamlet omitted by particular desire."

The strange disregard of order, so constantly manifested in this work, is even ludicrously exhibited in the subjects of the seventh and eighth chapters. The first of these, which is a long one, has for title, "Of Sensibility and Touch;" and what will our readers suppose to be the theme and title of the chapter which *follows* it? It is, "Of the Senses generally, *introductory to the Sense of Touch.*" In these, and in the chapter "On the Muscular Sense," there are, indeed, thrown together many interesting and acute observations; but the wise precept, that we should have "a place for every thing, and every thing in its place," is lamentably neglected.

Our author shows a sound judgment in the discussion of several theories which have from time to time been introduced by speculative philosophers, and enjoyed their day in the schools. One of these theories supposes that the limbs of an animal are modified *by* the circumstances, and not *for* the circumstances, in which it is placed. That for example, the neck of the giraffe has been gradually elongated, from generation to generation, because this remarkable quadruped has been obliged to reach up to the branches of trees to obtain its food; thus denying that a wise and kind Providence presided over the formation of this animal, and *so* formed it as to fit it to its condition. Another theory, referring to the extreme simplicity and apparent imperfection of the animals which existed in the earliest stages of the world, and which are now known to us by their fossil remains, imagines that nature has been gradually improving in her creative powers, and that these early beings were the productions of her "'prentice hand." Sir Charles Bell's answer to this notion is ingenious and conclusive. Another of these speculations, discussed and refuted by our author, is what has been called the "theory of elemental parts." It supposes that the same constituent materials enter into the composition of all animals, and that if, in any animal, a part be missing in a place where it is met with in the general model, this part is merely transferred, and is to be met with somewhere else. Thus, in the mammalia, a chain of bones in the ear is curiously adapted to convey the vibrations of the membrane of the tympanum to the nerve of hearing. In birds, this chain is wanting, and instead of it, a single bone, the *columella*, is substituted; and consequently parts are missing, and among them the *incus*. Now, say the speculators of this school, this part is found in what would otherwise be a new element, namely, a peculiar bone existing in the jaw or mandible of the bird, called the *os quadratum*, and which bears some resemblance to the incus. The hypothesis, even in this example, which is a plausible one, is easily overthrown. These theories have, however, only a distant connexion with the professed subject of the work. The last that we shall mention is immediately connected with it. It is the notion, first taught by ANAXAGORAS, that the superiority of man over all other animals, is owing to his hand, "the consummation of all perfection as an instrument." On this subject, which is treated in the last chapter of the work, our author very properly adopts the opinion of ARISTOTLE, that man is not the wisest of animals because he has hands, but that hands were given to him because he is the wisest of animals.

We cannot conclude our review, without again expressing our regret, that a confused plan and the unaccountable omission to describe the mechanism of the hand, must go far to make this work a failure, as regards its avowed object; but it would be unjust not to state, at the same time, that it gives us abundant evidence that the author had knowledge and talent to execute the task prescribed for him, if he had chosen to do so.

R. M. P.